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THE POLYCYSTID GREGARINES OF THE UNITED STATES.—Second Contribution.

BY HOWARD CRAWLEY.

I.

The following paper contains the results of my observations on gregarines during the spring and summer of 1903. Two new genera and several new species have been discovered. In addition, some observations on the biology of the animals are described. These concern the cysts and the time required for the maturation of the spores.

II.

ACUTISPORA n. g.

Cysts spherical, with a thick cuticular membrane. Dehiscence by means of an annular pseudocyst, which develops around one end of the ellipsoidal spore-mass, the two together having the form of an acorn. Spore-mass ellipsoidal and enclosed in a tough transparent membrane, which splits into two valves by a rupture extending around the major diameter. Maturation period intermediate.

Spores large, navicular in shape and showing epispore and endospore. Ordinarily symmetrical, but sometimes with the longer axis very slightly curved. Endospore a truncated double cone, but with a slightly curved profile, and furnished at either end with a thick, blunt refractive rod, the whole covered over by the epispore. Within a large spherical residuum, either central or lateral, around which the sporozoites are grouped.

The genus contains one species:

Acutispora macrocephala n. sp. Pl. XXX, figs. 1-6

Epimerite: Some of these animals showed an anteriorly directed prolongation of the protomerite which may possibly be regarded as constituting the epimerite. If so, this element is poorly developed and differs considerably in the different individuals. In some cases the entocyte extended into it.

Protomerite: Always showing a deep constriction at the beginning of the posterior third. Large, and relatively larger in the small than in the large animals. Separated from the deutomerite by a sharp constriction.

Deutomerite: Conical, with usually a bluntly rounded posterior end. Broadest just behind the septum and tapering gradually and uniformly.

Epicyte: Thick, showing a double contour all over the animal.

Sarcocyte: Poorly developed or wanting, except for the septum, which dips slightly backward.

Entocyte: Dense in all cases. In the smaller animals, slightly less dense in the protomerite than in the deutomerite.

Nucleus: Invisible.

Dimensions: Length of largest individuals seen, 600 microns.

Cysts: Spherical. Diameter 410 microns, with a cuticular membrane 40 microns thick. No gelatinous envelope. Dimensions of spore-mass 400 by 300 microns. Maturation period 10 days, May 10-20, 1903.

Spores: Length, 19 microns; breadth, 4 microns; refractive rods, 6 microns long.

Host: *Lithobius forficatus* Linn. Found in but one case, and then present in small numbers.

Locality: Raleigh, N. C.

GIGADUCTUS n. g.

Cysts spherical, with a thin gelatinous envelope. Dehiscence by one enormous sporoduct. Maturation period short.

Spores cylindrical, very large. Wall single, thick. Spores marked with diagonal lines, those on one side opposed in direction to those on the other, giving the spore a latticed appearance. These lines are apparently due to the sporozoites, which make up a hollow cylinder lying in contact with the inner surface of the spore wall. The residuum, an ellipsoidal mass liberally provided with granules, occupies the cavity of this hollow cylinder.

The single species is:

Gigaductus parvus n. sp. Pl. XXX, figs. 10-13.

Epimerite: Not seen.

Protomerite: In the primitives, generally forming somewhat more than a hemisphere. In the satellites, slightly shortened, with a straight anterior edge. Separated from the deutomerite by a sharp constriction.

Deutomerite: Cylindrical to conical, with a blunt posterior end.

Epicyte: Well developed, showing a double contour. Longitudinally striated.

Sarcocyte: Apparently wanting, except for the septum, which is either plane or dips slightly backward.

Entocyte: Coarsely granular; not dense.

Nucleus: Large, spherical.

Dimensions: Maximum size 150 microns long by 90 microns broad. The satellites are usually slightly smaller than the primites; but sometimes much smaller and sometimes larger. The smallest animal seen was 50 microns long.

Cysts: Diameter 170 microns. Gelatinous envelope 12 microns thick in the young cyst, but becoming very much thicker as maturation proceeds. Cysts remarkably uniform in size. Maturation period 2-3 days, August, 1903.

Spores: Cylindrical, 25 microns long by 10 microns broad. At the ends, the spore wall is raised into a little circular ridge.

Host: *Harpalus caliginosus* Fab. Infection only occasional, but the gregarines usually present in considerable numbers.

Locality: Wyncote, Pa.

There is a good deal of confusion regarding the gregarines occurring in the Diplopod family Julidæ. These gregarines all bear a certain amount of resemblance to one another, and it has been usual to relegate all of them to the species *Stenophora juli* Frantz. Léger et Duboscq (1903) have recently shown that such a procedure is not warranted for the fauna of Corsica, and the case is certainly the same for that of the eastern United States. The Julidæ of this region are infected with certainly two and possibly three species of *Stenophora*, while the classic *S. juli* apparently does not occur. Of these species, one is unquestionably the form described by Leidy (1853) as *Gregarina julipusulli*. As indicated by the specific name, Leidy considered its host to be *Julus pusillus* Say. According to Bollman (1887) this millipede, correctly *Julus minutus* Brandt, does not occur in Pennsylvania, and it may be that Leidy was mistaken in his identification. This matter is not, however, of any great importance, and the specific name of the gregarine must stand. Leidy spelled the specific name of the host *pusullus*, whereas Say's memoir (1821) renders it *pusillus*, which spelling will be used for the name of the gregarine. The description is as follows:

Stenophora julipusilli (Leidy). Pl. XXX, figs. 16, 17.

Gregarina julipusulli Leidy (1853), p. 238, Pl. 10, figs. 21, 22.

Stenophora juli Crawley (1903), p. 51.

Protomerite: Hemispherical to cylindro-conical to conical. In front a more or less evident papilla, through which there is an apparent pore. Ordinarily broader than long.

Deutomerite: Ordinarily cylindrical to flask-shaped. Occasionally ellipsoidal to oval. The cylindrical forms, in which the ratio of breadth to length is 1 to 4, display the tendency toward the assumption of the flask shape, in that the greatest breadth is in the posterior half. When the flask shape is assumed, the body of the flask may take up from one-third to three-fourths of the deutomerite. In such cases, the ratio of breadth to length may be as high as 1 to 2. The contour of the deutomerite is frequently slightly irregular.

Epicyte: Well developed. About 3 microns thick in the deutomerite, slightly thinner in the protomerite, except at the anterior tip. Here it is thickened and shows an apparent pore. There is no evidence that the epicyte is actually pierced, however, and the apparent pore is probably the rudiment of an epimerite. Longitudinal striations conspicuous.

Sarcocyte: Well developed all over the animal. About one-half as thick as the epicyte. Greatly thickened at the anterior tip of the protomerite. Septum thick, curving backward.

Myocyte: Easily demonstrated by the use of reagents, and visible in living animals under favorable circumstances.

Entocyte: Uniformly granular. Very dense in the larger animals. Granules of the protomerite differing in character from those of the deutomerite.

Nucleus: Spherical, with one large spherical karyosome.

Hosts: *Julus* and the smaller species of *Parajulus*. What is apparently the same gregarine is occasionally present in *Lysiopetalum lactarium* Say. Very common.

Locality: Eastern United States.

This species is easily separated from *S. juli* by the size of the protomerite. In *S. juli* the length of the protomerite, according to the figures given by Schneider (1875), makes up only about 6 per cent. of the total length. In *S. julipusilli* this proportion increases to 10 per cent. in the adults and 15 per cent. in the young. From *Stenophora varians*, recently described by Léger et Duboseq (1903), *S. julipusilli* differs in being a larger and bulkier animal and in having the breadth of the protomerite almost invariably greater than the length.

The Diplopod *Parajulus*, while frequently parasitized by *Stenophora julipusilli*, shows at times other gregarines which cannot be placed in that species. These present themselves under several forms, the differences between which, if permanent, are certainly of specific value. My observations, however, have not as yet been thorough

enough to determine how many distinct species there are, and the matter will be reserved for a future communication.

For the following new species, the data at present on hand are not sufficient to warrant formal definitions.

Actinocephalus americanus n. sp. Pl. XXX, fig. 22.

This species is created for a single individual found in *Galerita bicolor* Drury. The beetle is quite common and I have opened perhaps twenty individuals, but only one was parasitized, and then but the one gregarine was present. It is probable that the parasite is only sporadically present in *Galerita*, and that its usual host is some other animal. It is, however, distinct from any of the common species occurring at Wyncote. It is placed in the genus *Actinocephalus* on account of the form of both protomerite and deutomerite, the presence of several karyosomes in the nucleus, and the fact that its host was a carnivorous Arthropod.

The gregarine was 200 microns long, 35 of which represented the length of the protomerite. The two segments were each about 45 microns broad. The epicyte was very distinct and showed a little papilla at the anterior tip of the protomerite. The septum curved forward and the nucleus showed several karyosomes. The entocyte was much denser in the deuteromite than in the protomerite. The animal progressed quite freely in a circle of short radius, but was prevented from taking any lengthy excursions by the surrounding host tissue.

Hoplorhynchus scolopendras n. sp. Pl. XXX, fig. 19.

This species is created for a gregarine parasitic in *Scolopendra woodi* Meinert, from Raleigh, N. C. Two specimens were present. One of these, when first seen, was a balloon-shaped sac, 350 microns long by 200 broad. The epicyte and sarcocyte were each nearly or quite 3 microns thick, and the former was plainly marked with longitudinal striations. Both of the individuals were very flexible, readily changing shape and showing extensive contortions.

After having been upon the slide for perhaps an hour, the parasites became quiescent and assumed what was probably something like the typical shape. The larger then measured 825 microns long by 120 microns broad. The anterior end, as shown in fig. 19, was much narrower than the balance of the animal, but it is somewhat questionable if this narrowing be permanent. A distinct septum extended across this narrower region, cutting off a portion of granular entocyte.

Backward from the broadest portion, the animal's body tapered gradually, ending behind in a point.

This species is placed in the genus *Hoplorhynchus* on account of its close resemblance to *H. actinotus* Leidy and its occurrence in a centipede related to *Scolopocryptops*, the host of the latter.

Trichorhynchus lithobii n. sp. Pl. XXX, fig. 18.

This animal, which is apparently specifically distinct from any of the other gregarines parasitic in *Lithobius*, was found in a specimen of that centipede from Raleigh, N. C. An epimerite was not seen. The protomerite was subcordiform, and displayed in front a differentiation the exact nature of which could not be determined. The deutomerite varied considerably in shape, the animal being quite polymorphic. Both epicyte and sarcocyte were distinct and of about equal thickness. The septum was thick and curved backward. The entocyte was not dense; the nucleus large, with several karyosomes. The largest individual seen was 195 microns long.

Figs. 20 and 21 show a small gregarine frequently encountered in *Scolopocryptops sexspinosus* Say. Fig. 21 is doubtless that of a very young specimen which has been loosened from its original attachment by the breaking up of the host intestine upon the slide. The three segments are all marked out. It seems almost certain that this figure represents a young *Hoplorhynchus actinotus* Leidy. The animal shown in fig. 20 was very like the other in general appearance and had the paleness characteristic of a young animal. There was, however, no epimerite, nor did the individuals seen show any indications of recent mutilations. *H. actinotus* may retain the epimerite until it reaches a length of 700 microns, whereas the animal here figured was only 45 microns long. The observed facts are capable of two interpretations. The one is that *H. actinotus* is to a certain extent dimorphic; that is, the epimerite may be lost very early or it may be retained until the animal has reached nearly or quite the maximum size. The other is that while fig. 21 represents a young individual of *H. actinotus*, fig. 20 is that of a different species. The matter is, however, one best held under advisement until additional facts are obtained.

There follow certain addenda, mostly with regard to the cysts and spores, to the characters of species previously described.

Actinocephalus harpali (Crawley). Pl. XXX, fig. 14.

Gregarina harpali Crawley (1903), p. 49, Pl. 1, figs. 1-4.

To the characters given in my original description of this species add:

Cysts: When first obtained, 640 microns in diameter, with a cuticular membrane 95 microns thick. The true cyst mass was therefore 450 microns in diameter, and this size was maintained. On the other hand, the cuticular membrane swelled enormously and became ovoid, finally reaching a length of 1150 microns and a breadth of 1000. The cyst opened by simple rupture where this membrane was thinnest. Sporulation was apparently total. Maturation period 9 days, August 14–23, 1903.

Spores: Length 9 microns; breadth $7\frac{1}{2}$ microns. Diamond-shaped in longitudinal and hexagonal in transverse section. Spore wall single, thick, with the cavity entirely filled with hyaline protoplasm containing one or two large to many small granules. The spores were mostly adherent in files or masses, this arrangement being apparently due to a thin pellicle of some gelatinous substance covering the spore wall.

This gregarine reaches a maximum length of 1200 microns. It is very common, being present in considerable numbers in nearly every beetle opened. On the other hand, at least from June to August, the cysts are rare, the above data being obtained from a single specimen.

***Gregarina calverti* Crawley.** Pl. XXX, fig. 15.

Gregarina calverti Crawley (1903), p. 48, Pl. 2, figs. 19–21.

To the original description given of this species add:

Cysts: Spherical, with a cuticular membrane showing concentric striæ. No gelatinous envelope. The young cysts show a second hyaline membrane, 3–4 microns thick, within the striated membrane. Cysts varying in diameter from 250 to 360 microns, the membrane varying in thickness from 20–40 microns. The larger cysts do not necessarily possess the thicker membranes. The cysts are probably in all cases the result of a fusion of two gregarines. Dehiscence effected by sporoducts, from 4–8 in number, not exceeding in length the diameter of the cyst. Sporoducts not always all used in the projection of the spores. Maturation period 4 days, August 18–22, 1903.

Spores: Doliform, 13 microns long by 5 microns broad. A single thick spore wall, which is enclosed within a gelatinous pellicle, serving to hold the spores together in files. Spore contents at first wholly hyaline, but rapidly differentiating into a central spherical residuum and two groups of sporozoites.

***Cnemidospora spiroboli* (Crawley).** Pl. XXX, figs. 7–9.

Stenophora spiroboli Crawley (1903), p. 51, Pl. 2, fig. 22.

To the descriptions originally given of this species add:

Cysts: Spherical, 350–500 microns in diameter, with a cuticular mem-

brane generally about 20 microns thick, but often much thicker. This variation in the thickness of the membrane appears to be due to the quantity of extraneous matter which gets tangled within it as it forms. It was noticeable that the thin walls were clear and clean, while the thick walls were very much matted with substance from the host's intestine. Dehiscence by a slit which, in the cases observed, extended only part way around the cyst. Sporulation partial. Maturation period 8 days, May 17-25, 1903.

Spores: Length $12\frac{1}{2}$ microns; breadth $7\frac{1}{2}$ microns. Two coated, the episore of some consistent gelatinous substance; the endospore cuticular. The latter presents an elliptical profile, with slightly protruding ends, whereas the episore is pulled out considerably at the ends, and somewhat irregular in outline. Sporoplasm hyaline, with a central mass of granules. The spores adhere in files and masses.

Gregarina achetæabbreviatæ Leidy.

Gregarina achetæabbreviatæ Leidy (1853), p. 238, Pl. 11, figs. 33, 34.

Gregarina achetæabbreviatæ Crawley (1903), p. 45, Pl. 3, figs. 34, 35.

To the previous notices of this species add:

Cysts: Spherical, enclosed in a more or less irregularly shaped thick gelatinous envelope. Diameter of the cyst mass, without the gelatinous envelope, 225 microns. Cuticular membrane 6-8 microns thick. The gelatinous envelope varied in thickness from 100-300 microns. Dehiscence by sporoducts, 2-5 in number, reaching a length of 1000 microns. Prior to evagination, the situation of the sporoducts is plainly indicated by the appearance around the periphery of the cyst of dense discoid masses, yellowish in color. This yellowish color is due to the presence of an oil, which, when the sporoducts evert, appears to be within the substance of their walls, and not within their lumina. The two cysts obtained everted their sporoducts one day after removal from the host intestine.

Spores: Unknown, for, rather curiously, although the sporoducts everted, no spores appeared.

The list of the polycystid gregarines of the United States, revised to date, is as follows:

Fam. **GREGARINIDÆ.**

1. GREGARINA BLATTARUM Sieb.
2. GREGARINA ACHETÆABBREVIATÆ Leidy.
3. GREGARINA PASSALICORNUTI Leidy.
4. GREGARINA CALVERTI Crawley.
5. GIGADUCTUS PARVUS Crawley.

6. *HIRMOCYSTIS OVALIS* Crawley.
7. *EUSPORA LUCANI* Crawley.
8. *CNEMIDOSPORA SPIROBOLI* Crawley.

Fam. **STENOPHORIDÆ**.¹

9. *STENOPHORA JULIPUSILLI* Leidy.

Fam. **DACTYLOPHORIDÆ**.

10. *ECHINOMERA HISPIDA* Aimé Schn.
11. *ECHINOMERA MICROCEPHALA* Leidy.
12. *TRICHORHYNCHUS PULCHER* Aimé Schn.
13. *TRICHORHYNCHUS LITHOBII* Crawley.
14. *ACUTISPOA MACROCEPHALA* Crawley.

Fam. **ACTINOCEPHALIDÆ**.

15. *AMPHOROIDES FONTARÆ* Crawley.
16. *ASTEROPHORA PHILICA* Leidy.
17. *ASTEROPHORA CRATOPARIS* Crawley.
18. *STEPHANOPHORA LOCUSTÆCAROLINÆ* Leidy.
19. *BOTHRIOPSIS HISTRIO* Aimé Schn.
20. *ACTINOCEPHALUS DUJARDINI* Aimé Schn.
21. *ACTINOCEPHALUS HARPALI* Crawley.
22. *ACTINOCEPHALUS AMERICANUS* Crawley.

Fam. **MENOSPORIDÆ**.

23. *HOPLORHYNCHUS ACTINOTUS* Leidy.
24. *HOPLORHYNCHUS SCOLOPENDRAS* Crawley.

Fam. **DOLIOCYSTIDÆ**.

25. *DOLIOCYSTIS RHYNCOBOLI* Crawley.

In addition to the above, there are eight more species. These are all placed in the genus *Gregarina*, but since in no case are either the cysts or spores known, the correctness of this disposition is decidedly in doubt. It is therefore impossible to say to which family they belong. They are as follows:

26. *GREGARINA TERMITIS* Leidy.
27. *GREGARINA SCARABEIRELICTI* Leidy.
28. *GREGARINA MELOLONTHÆBRUNNEÆ* Leidy.
29. *GREGARINA POLYDESMIVIRGINIENSIS* Leidy.
30. *GREGARINA ELATERÆ* Crawley.

¹ Established by Léger et Duboscq (1903).

31. GREGARINA DICÆLI² Crawley.
32. GREGARINA XYLOPINI Crawley.
33. GREGARINA BOLETOPHAGI Crawley.

III.

The time required for a gregarine cyst to mature appears to vary to a very remarkable degree. I have information on seven species, as follows:

	No. of days.	Month.
GREGARINA ACHETÆABBREVIATÆ.....	1	August.
GIGADUCTUS PARVUS.....	2-3	August.
GREGARINA CALVERTI.....	4	August.
CNEMIDOSPORA SPIROBOLI.....	8	May.
ACTINOCEPHALUS HARPALI.....	9	August.
ACUTISPORE MACROCEPHALA.....	10	May.
ACTINOCEPHALUS DUJARDINI.....	30	April-May.

Although the number of cases is quite small, they point to one or two facts of general interest. The first three species mentioned, in which the period varies from one to four days, are all animals of which the cysts open by means of sporoducts. This suggests the conclusion that when sporoducts are developed the maturation period is shortened, although wherein the signification of this apparent correlation may lie is decidedly problematical.

The most striking case is that of *Gregarina achetæabbreviatæ*. These cysts had not passed to the exterior in the usual way, but were obtained from the intestinal contents of a slaughtered cricket. They then showed the yellowish disks indicative of the approaching eversion of the sporoducts (see p. 639), and in consideration of the short time which elapses from the appearance of these disks to eversion, it is not unlikely that the process may take place in the host intestine. There is no inherent unlikelihood in such an event, although it would probably not lead to auto-infection. The spores, released in the fecal masses of the posterior portion of the cricket gut, would merely pass to the exterior free instead of enclosed within a cyst, there to await their destiny.

In the case of *Gigaductus parvus* the cysts were also removed from the host intestine, which gives this species a very short period. The cysts of *Gregarina calverti* were obtained from the feces of the host, and hence the four days represents the time required after the cyst has

² Incorrectly given as *discoli* in the original description.

reached the outside world. In the case of this species, I obtained quite a number of cysts, all of which went through the process in approximately the same time. It is also worthy of note that the spores of these two species mature rapidly. Those of *Gigaductus parvus* showed differentiation into sporozoites as soon as they were ejected from the cysts. *Gregarina calverti* was a trifle slower, but the sporozoites were to be detected within half a day after dehiscence.

Cnemidospora spiroboli, *Actinocephalus harpali* and *Acutispora macrocephala* showed periods of from 8 to 10 days. Of these three species, the cysts of the first two dehisce by simple rupture, that of the third by the formation of a pseudocyst. *A. dujardini*, which was thirty days maturing, also dehisces by simple rupture. Although the facts are few, they point to the conclusion that when dehiscence is by rupture, maturation is a slower process than when sporoducts are formed. Further, the spores of these last-named species did not, for several days, show any differentiation into sporozoites. Of course, temperature is a factor in determining the time, but the cysts of *A. harpali* were exposed to exactly the same conditions as those of the two species of *Gregarina* and of *Gigaductus parvus*.

IV.

The cysts of *Acutispora macrocephala* present some points of interest. They were obtained on May 10, from a specimen of *Lithobius forficatus*, sent me from Raleigh, N. C. At this time they were perfectly spherical, 420 microns in diameter, with a cuticular wall 40 microns thick. There were several cysts in the intestine of the myriapod, all about the same size, and of these two matured. On May 18, the appearance presented is shown in Pl. XXX, fig. 4. The protective membrane was still clear and the cyst proper still very dense. One hemisphere was now considerably larger than the other, and on the surface of this larger hemisphere there were a few indistinct furrows. These furrows do not appear to possess any especial signification, although they may be taken as a sign that the cyst is nearly mature. Two days later, May 20, the cyst presented quite a different aspect. The protective membrane had swollen greatly and was evidently undergoing a rapid decay (fig. 5). At one pole, the upper in the figure, it was much thinner than elsewhere, and it was from this pole that the spores eventually emerged. Within lay the cyst mass, now having the form of an acorn, and consisting of an ellipsoidal body, around one end of which was a thick ring. At the free end of this ellipsoidal body, which is the spore mass, a definitive membrane could be seen. This membrane, although presenting a

curved contour, did not fit closely the internal mass of spores, whence the presence of a liquid may be assumed. The ring-shaped pseudocyst presented the same general appearance as the spore mass, and it also appeared to be inclosed by a membrane. The pseudocyst was so dense that the ellipsoidal body could not be seen through it, but a deep furrow could be detected extending around the line of juncture, giving the entire element the optical section seen in fig. 6. The diameter of the sphere formed by the protective membrane was considerably greater, and now measured 750 microns, as against 420 microns when removed from the centipede.

The next day the cyst had dehisced. It now showed a membranous bag, lying within the disintegrated remains of the pseudocyst. This bag showed two valves, and may be compared with the split shell of a walnut. It was evidently of tough consistence, since movements of the cover-glass, while rumpling it considerably, failed to tear it. It was entirely empty, which fact would seem to indicate that the spores are projected from the cyst with some force when dehiscence takes place.

The mechanics of the process are probably somewhat as follows: The formation of the bulky pseudocyst at one pole causes a gradual weakening of the protective membrane at this pole. In the condition illustrated in fig. 5 the protective coating appears to be reduced to a thin shell enclosing an empty space. This space, however, is doubtless occupied by the substance of the membrane, rendered transparent by the presence of a liberal quantity of water. Eventually the membrane, weakened by the absorption of water, and pressed upon from within by the pseudocyst, yields at the thinnest place and the contained mass is released. Whether the ellipsoidal body splits on account of the opening of the protective membrane, or by means of the liquid which it evidently contains, I do not know. The latter seems to be the more probable reason.

The annular mass has been termed, and I think correctly, a pseudocyst, yet it by no means possesses the permanent nature which this element sometimes displays. It seems probable that we should find various conditions from a mere residual mass to a definitive pseudocyst, since the latter condition is evidently derived from the former. In the case of *Acutispora*, the condition may probably be regarded as intermediate. The pseudocyst has become more than a mere residuum, but has not acquired the definitiveness it reaches in a genus like *Stylorhynchus*.

Cnemidospora spiroboli presents the less evolved condition. In this.

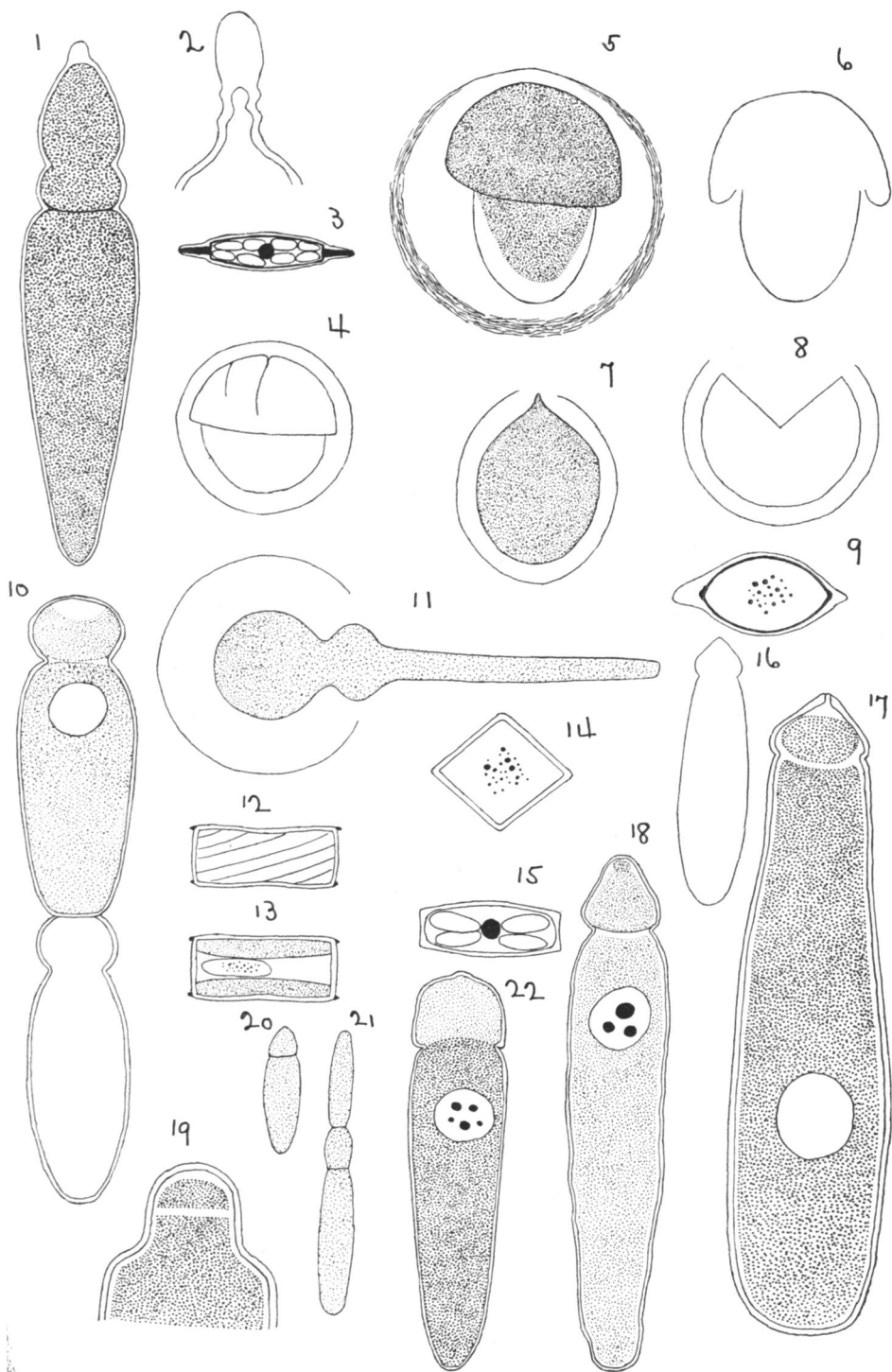
case there remained, after dehiscence, a spherical shell, across the surface of which a long rent extended. Within was a considerable quantity of granules, which, upon pressure, escaped from the cyst in two or three large masses. Here we have the primitive condition, a mere residuum, which no doubt takes part in dehiscence by swelling.

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EXPLANATION OF PLATE XXX.

- Fig. 1.—*Acutispora macrocephala* (p. 632). Sporont.
 Fig. 2.—*Acutispora macrocephala* (p. 632). Supposed epimerite.
 Fig. 3.—*Acutispora macrocephala* (p. 632). Spore.
 Figs. 4-6.—*Acutispora macrocephala* (p. 632). Cysts.
 Fig. 7.—*Cnemidospora spiroboli* (p. 638). Cyst about to dehisce.
 Fig. 8.—*Cnemidospora spiroboli* (p. 638). Empty cyst.
 Fig. 9.—*Cnemidospora spiroboli* (p. 638). Spore.
 Fig. 10.—*Gigaductus parvus* (p. 633). Association of two sporonts.
 Fig. 11.—*Gigaductus parvus* (p. 633). Cyst with everted sporoduct.
 Figs. 12, 13.—*Gigaductus parvus* (p. 633). Spores.
 Fig. 14.—*Actinocephalus harpali* (p. 637). Spore.
 Fig. 15.—*Gregarina calverti* (p. 638). Spore.
 Fig. 16.—*Stenophora julipusilli* (p. 634). Outline figure of young animal.
 Fig. 17.—*Stenophora julipusilli* (p. 634). Adult.
 Fig. 18.—*Trichorhynchus lithobii* (p. 637). Sporont.
 Fig. 19.—*Hoplorhynchus scolopendras* (p. 636). Anterior end of relaxed animal.
 Fig. 20.—Small gregarine found in *Scolopocryptops* (p. 637).
 Fig. 21.—Small gregarine found in *Scolopocryptops*. Supposed to be the young of *H. actinotus* (p. 637).
 Fig. 22.—*Actinocephalus americanus* (p. 636). Sporont.



CRAWLEY ON GREGARINES.